Searches for a High Mass Higgs Boson at the Tevatron

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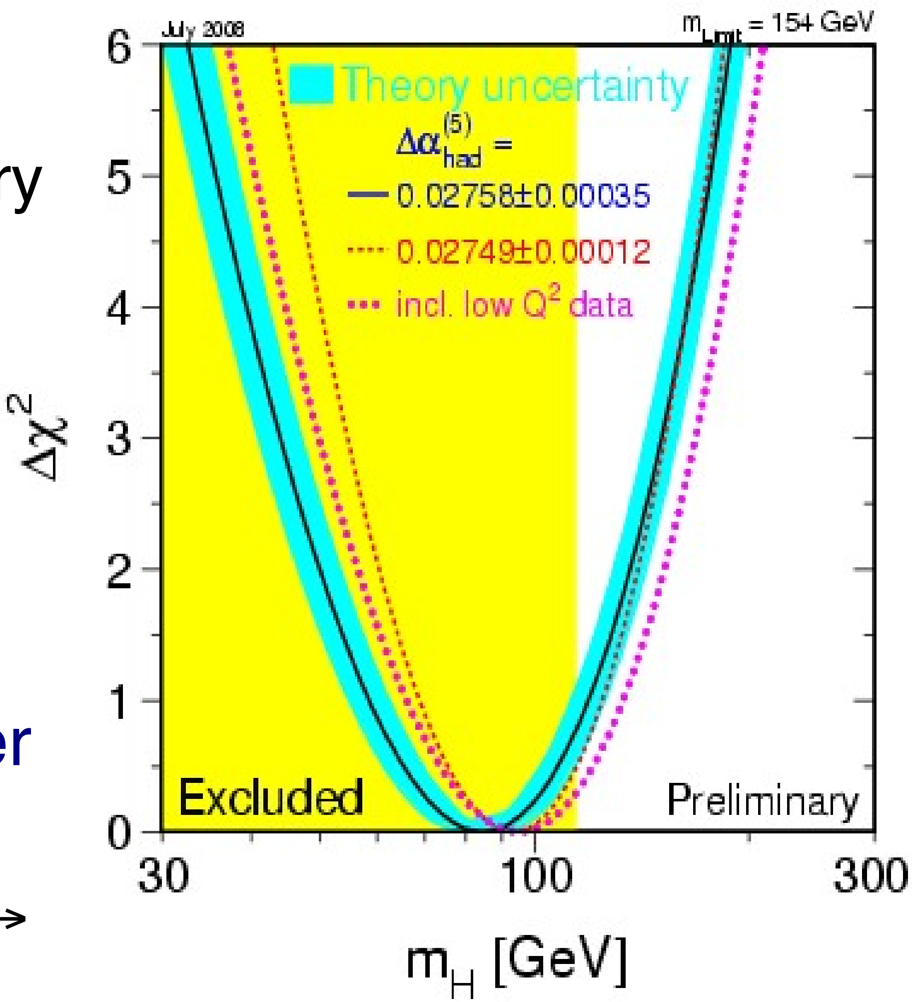
Aspen Winter Conference, Aspen, CO

February 8-14, 2009

Standard Model and the Higgs

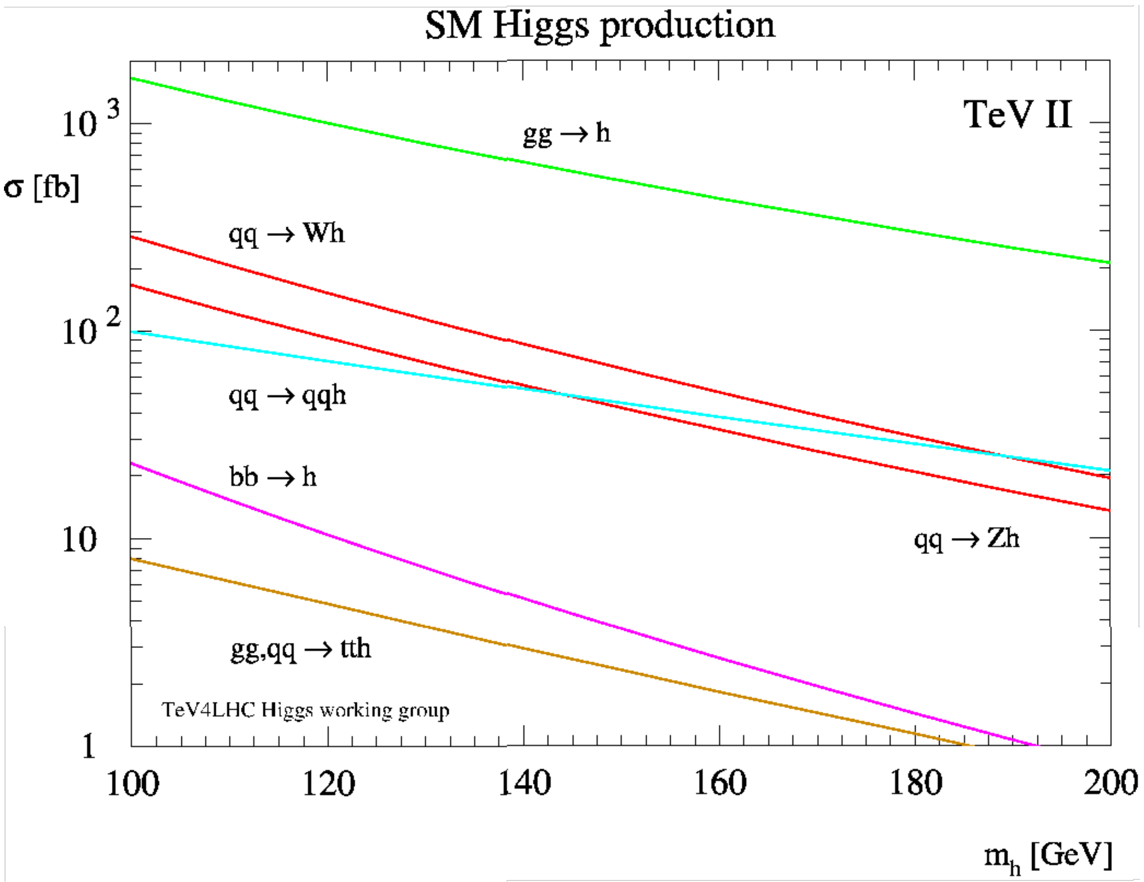
- Standard Model needs Higgs or Higgs-like mechanism to:
  - Explain electroweak symmetry breaking
  - Give particles mass
- Direct Higgs searches at LEP
  - Exclude Higgs of $M_H < 114.4$ GeV at 95% C.L.
- Indirect constraints from electroweak data prefer lighter Higgs ($M_H < 154$ GeV)
  - Combined with LEP results → upper limit of $M_H < 185$ GeV

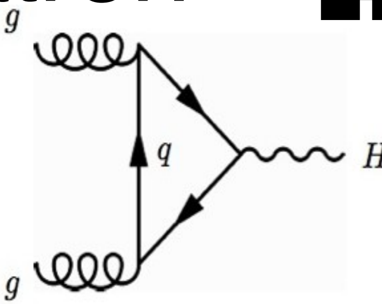


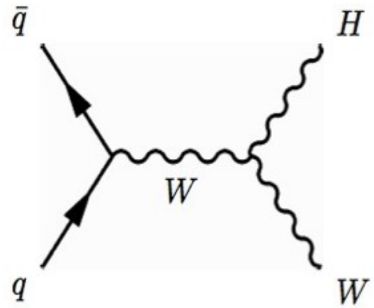
Plot from LEP EWK Working Group

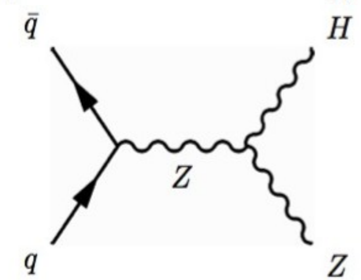
Higgs Production at the Tevatron

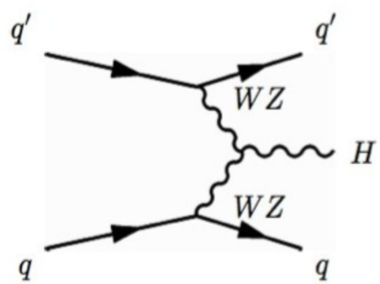
- Four main production mechanisms
  - Gluon fusion dominant process at Tevatron
  - Associated production (WH, ZH) and vector boson fusion contribute more at low M_H





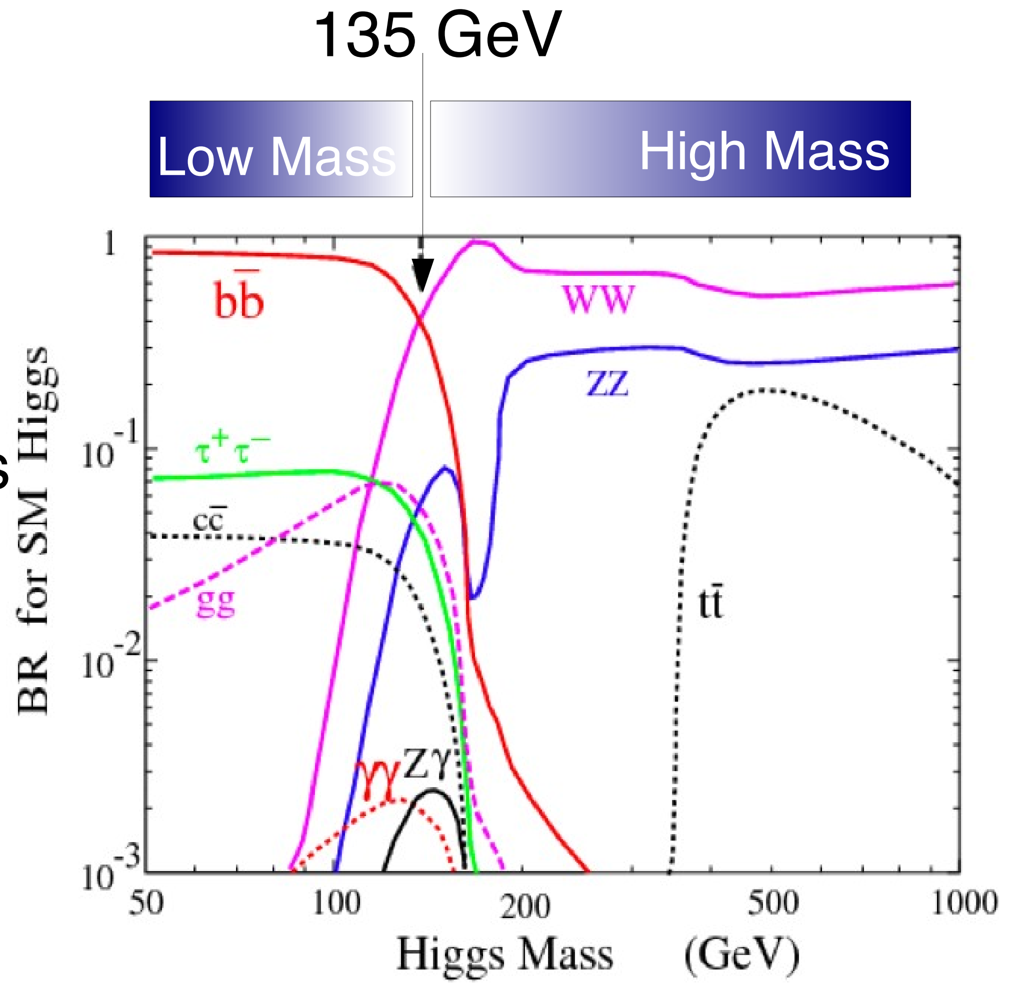






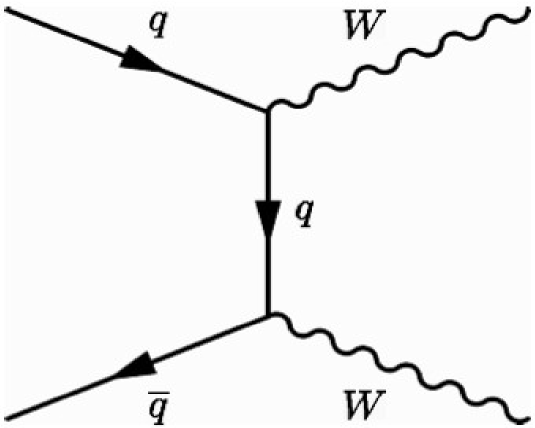
Standard Model Higgs Decay

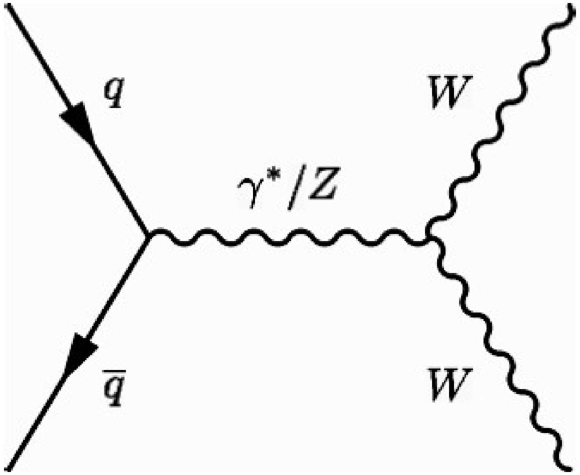
- Higgs decay modes depend on Higgs mass m_H
- For gg → H → WW σ x BR,
  - Peak sensitivity at $M_H \sim 160$
- WW decay modes
  - Hadronic W decay modes have large QCD bkg
  - Dilepton (e, μ): BR ~ 6%
    - Sensitive to τ → (e, μ)
    - Small BR, but... clean, easy to trigger
- High mass Higgs search: $H \to WW \to l\nu l\nu$



H → WW → $l\nu l\nu$ Backgrounds

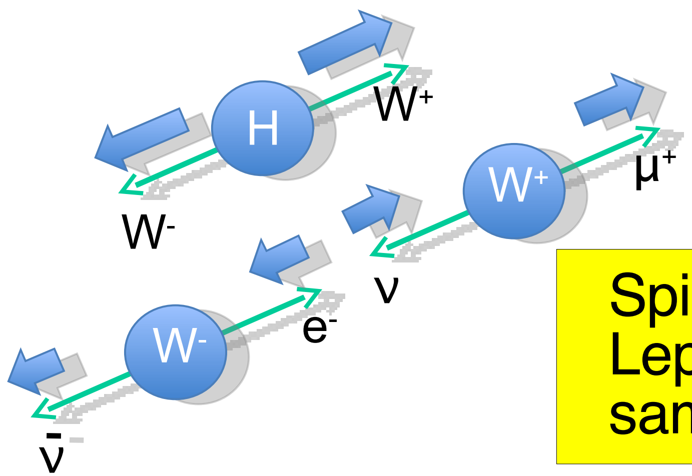
- Standard Model processes create a variety of backgrounds:
  - WW – one of the largest backgrounds
  - Heavy diboson: WZ, ZZ
  - $t\bar{t}$ and single top
  - Drell-Yan ($Z \to ll$)
  - W + jets/γ
- All cross sections measured by Tevatron experiments
  - Many discovery analyses:
    - WW, WZ, ZZ, single top



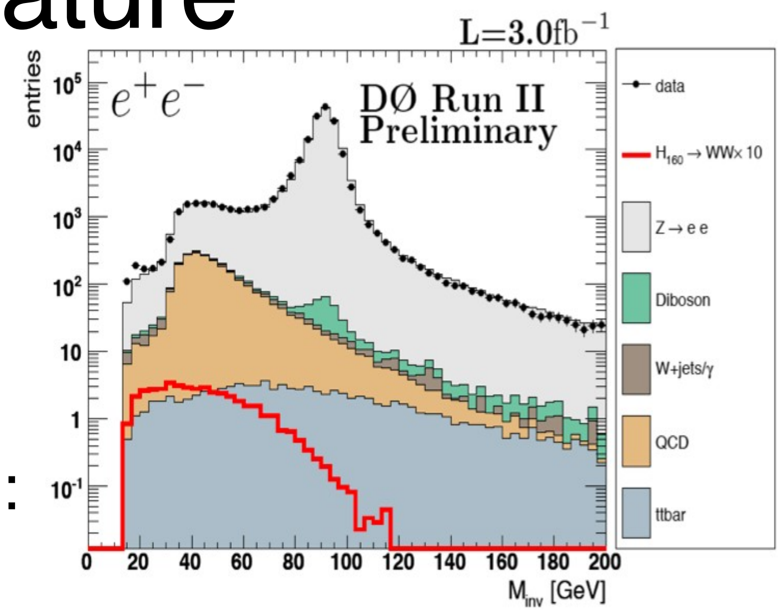


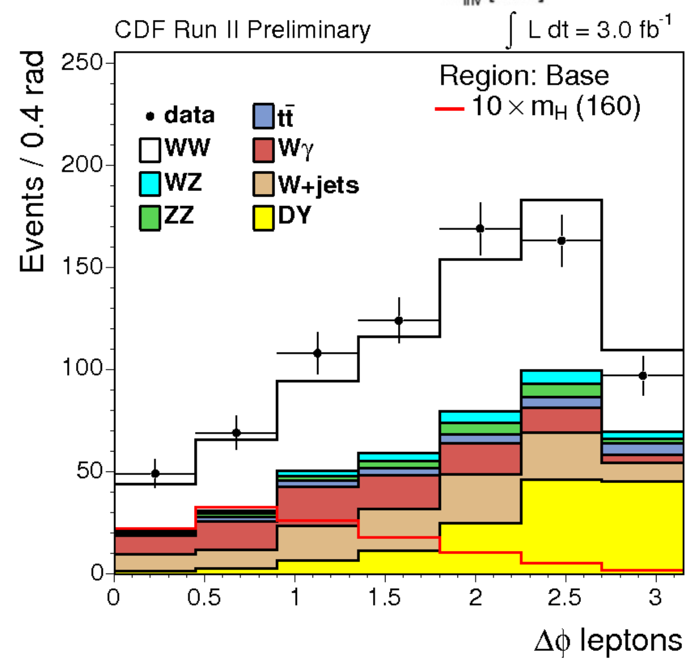
$H \to WW \to l\nu l\nu$ Signature

- Decay kinematics
  - 2 high p_T leptons (e or μ)
  - Missing transverse energy
  - Broad invariant mass spectrum
  - WW pair from spin-0 Higgs boson:



Spin correlation: Leptons go in the same direction

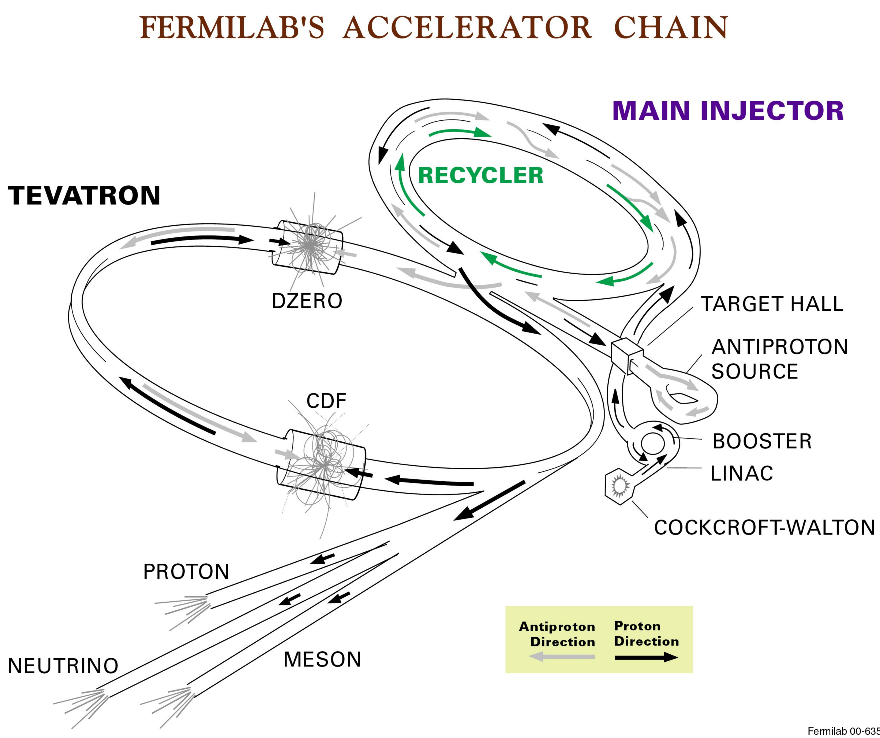


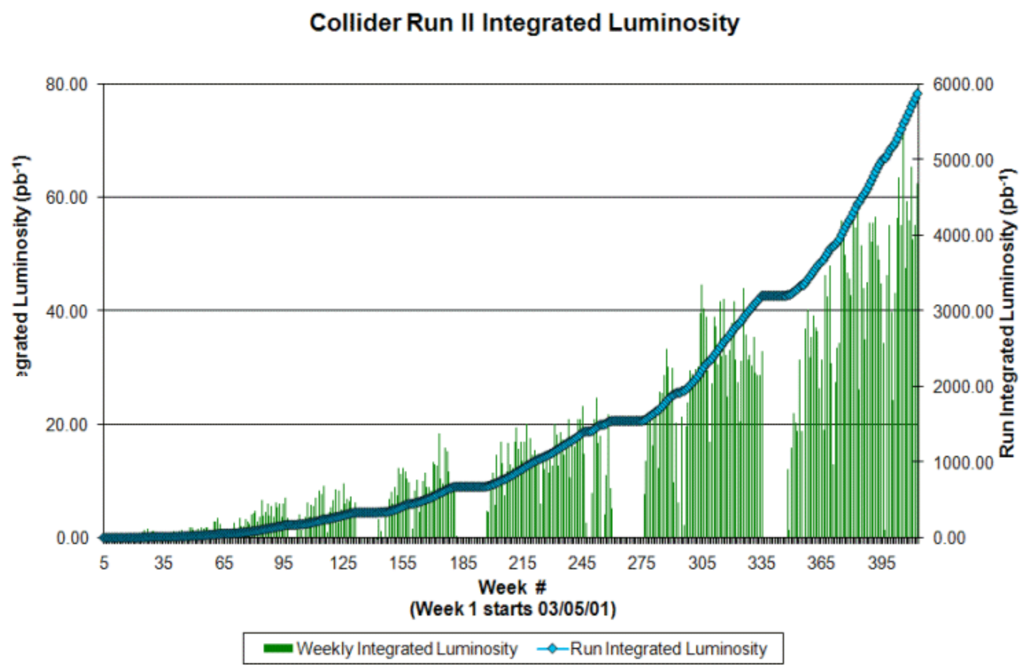


- Dilepton opening angle strongest background discriminant

Tevatron Performance

- Collide $p\bar{p}$ at $\sqrt{s}$ = 1.96 TeV
- Integrated over 250 pb^{-1} of data in January 2009

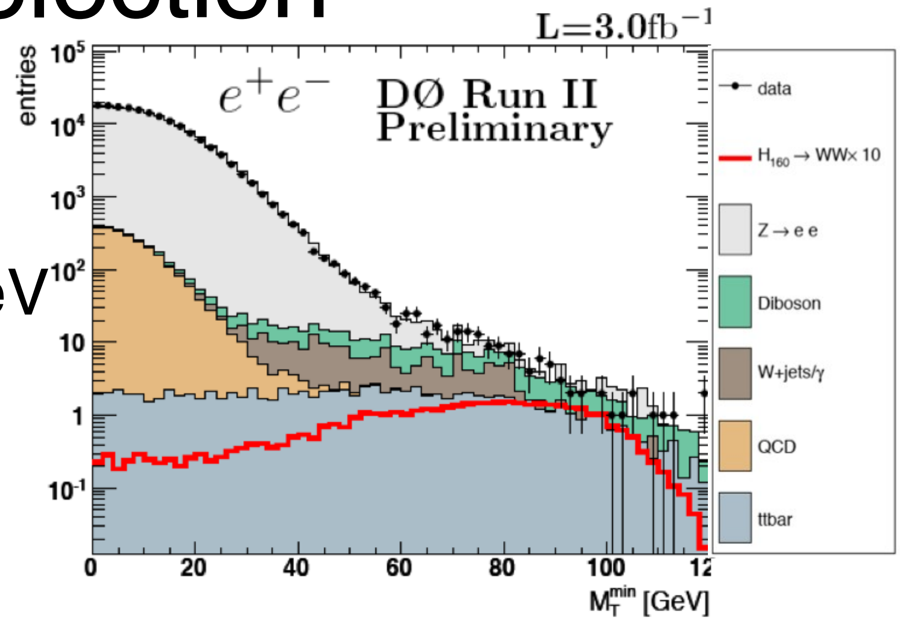




- Both experiments have acquired about 5 fb^{-1}
  - Today's results use up to 3 fb^{-1}

H → WW → $l\nu l\nu$ Selection

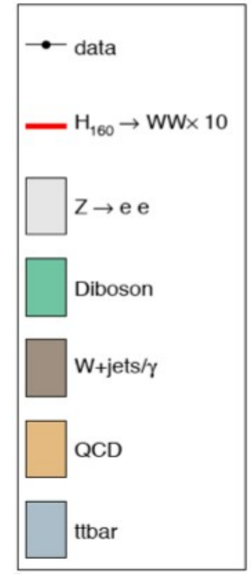
- Separate by dilepton type
- Trigger on one high-p_T lepton
  - $p_T(\mu) > 10$ GeV, $p_T(e) > 15$ GeV
  - Two opposite charge leptons
  - Isolation cuts
  - $M_{ll} > 15$ GeV

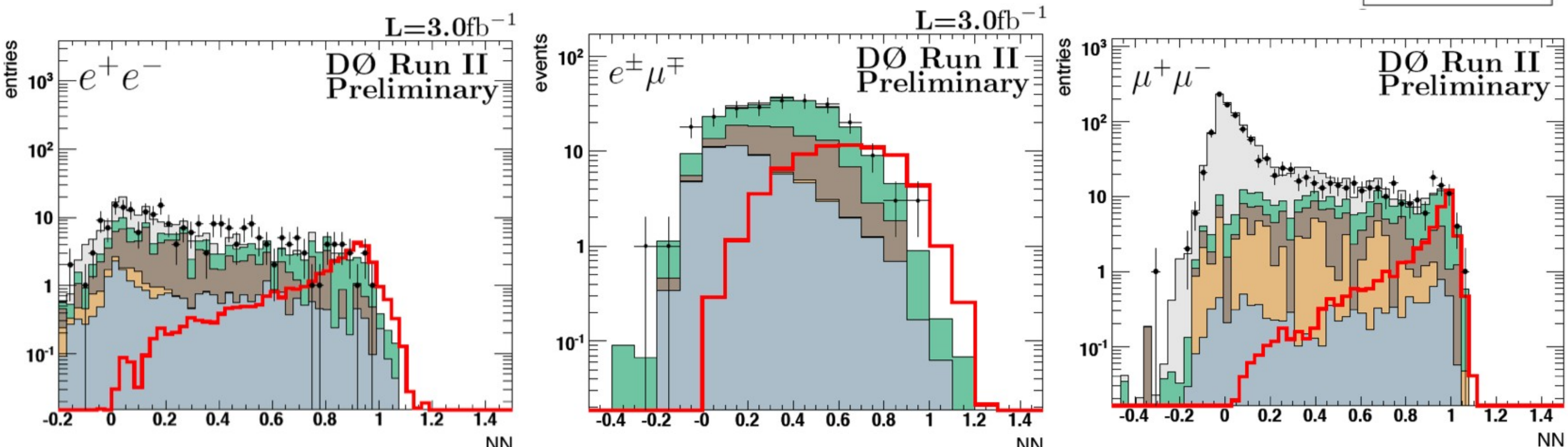


Final state	$e\mu$	ee	$\mu\mu$
$\not{E}_T$ (GeV)	> 20	> 20	> 20
$\not{E}_T^{\text{scaled}}$	> 7	> 6	> 5
$M_t^{\min}(l,\not{E}_T)$ (GeV)	> 20	> 30	> 20
$\Delta\phi(l,l)$	< 2.0	< 2.0	< 2.5

H → WW → $l\nu l\nu$ Neural Nets

- Expect ~15 Higgs events over ~1600 background
- Train one NN for each dilepton channel at each Higgs mass (5 GeV steps)
  - 11 kinematic input variables
- NN output distributions used to set limits
  - Limits calculated using Modified Frequentist (CL_s)





H → WW → $l\nu l\nu$ Systematics

Syst(%)	Signal	ΣBkg
JES	0.3	1.1
Jet ID	6.0	0.0
PV Rew	0.9	0.6
Z-p_T Rew	4.6	0.
WW NLO	6.8	3.0
σ	5	4
Multijet	0	2
PDF	4	4
Lepton ID	5.7	5.7

- Two classes of systematic:

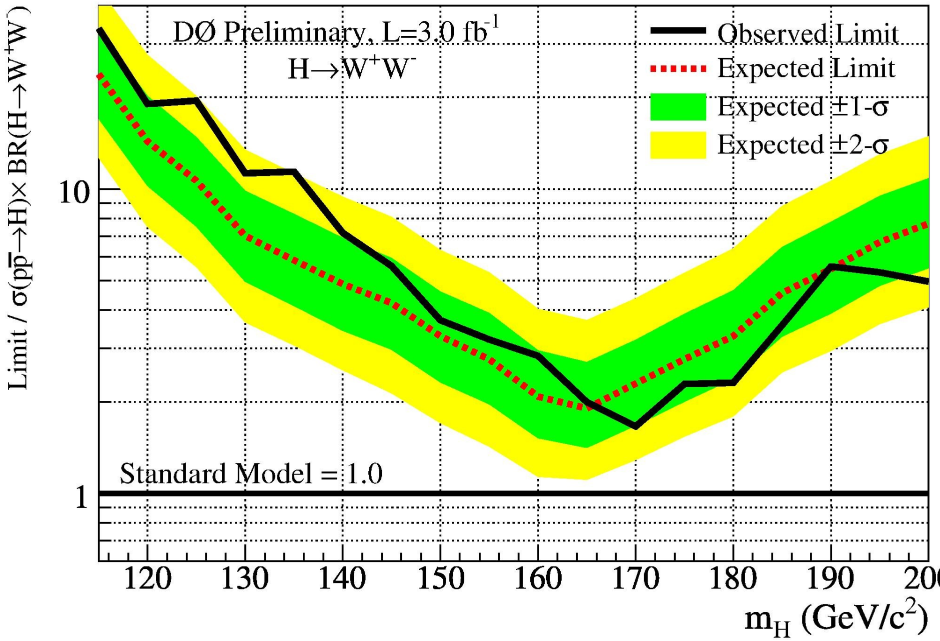
Shape systematics

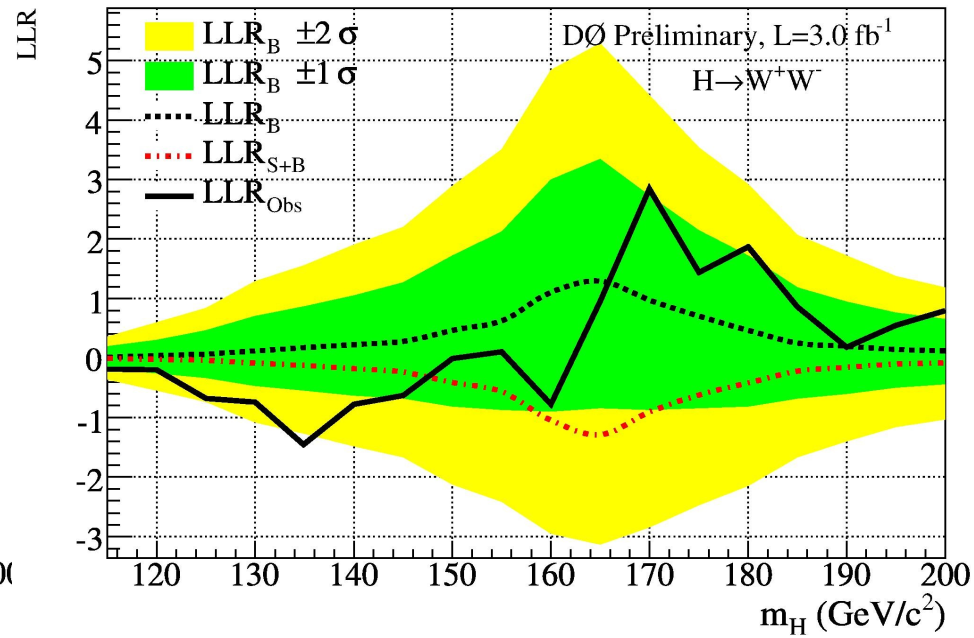
  - Modify output of discriminant
  - Also change normalization

Flat systematics

  - Affect only normalization, do not modify shape

$H \rightarrow WW \rightarrow l\nu l\nu$ Limits

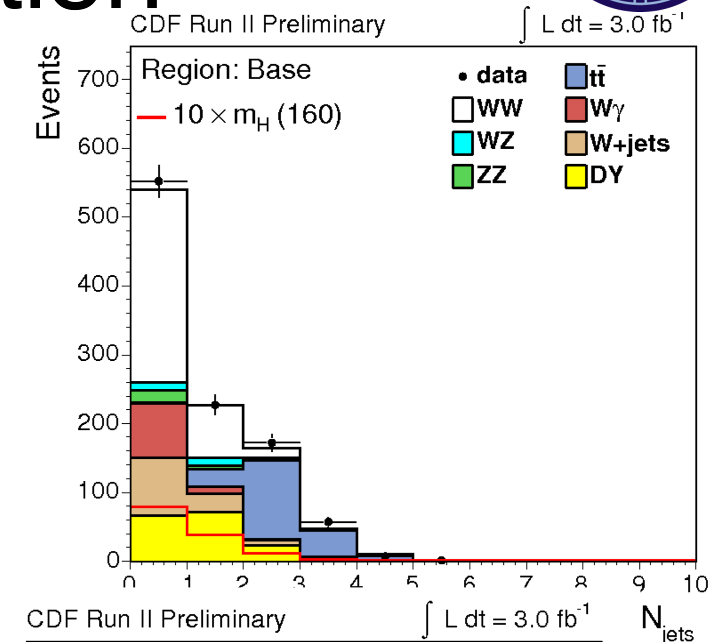


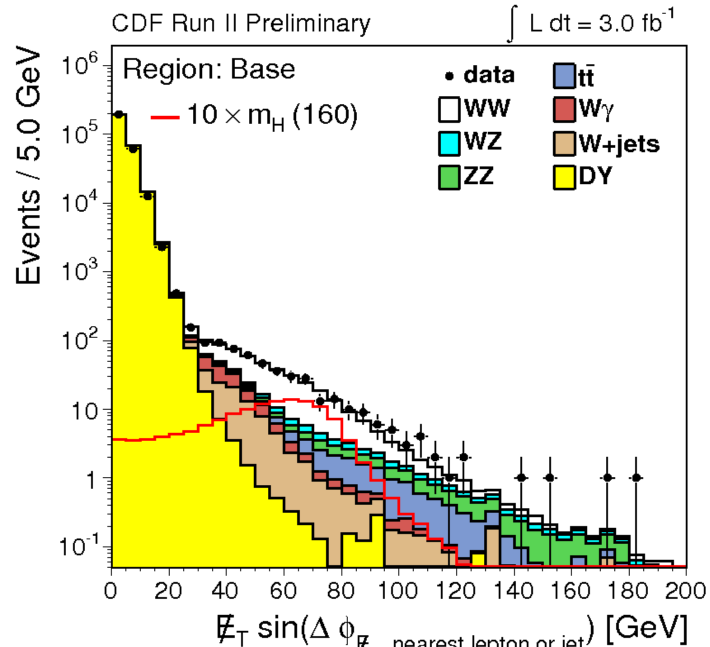


- Expected limits
  - At M_H = 165, expected limit of 1.9 times the Standard Model cross-section σ_{SM}
- Observed limit at M_H = 165: 2.0 x σ_{SM}

$H \rightarrow WW \rightarrow l\nu l\nu$ Selection

- Separate analysis by number of jets (0, 1, and ≥ 2)
- Trigger on one high-p_T lepton
  - $p_T(l_1) > 20$ GeV, $p_T(l_2) > 10$ GeV
  - Two opposite charge leptons
  - $M_{ll} > 16$ GeV/c^2
  - $\not{E}_T^{spec} > 25$ GeV (ee, μμ)
  - $\not{E}_T^{spec} > 15$ GeV (eμ)
- Separate by lepton quality into high and low S/B regions

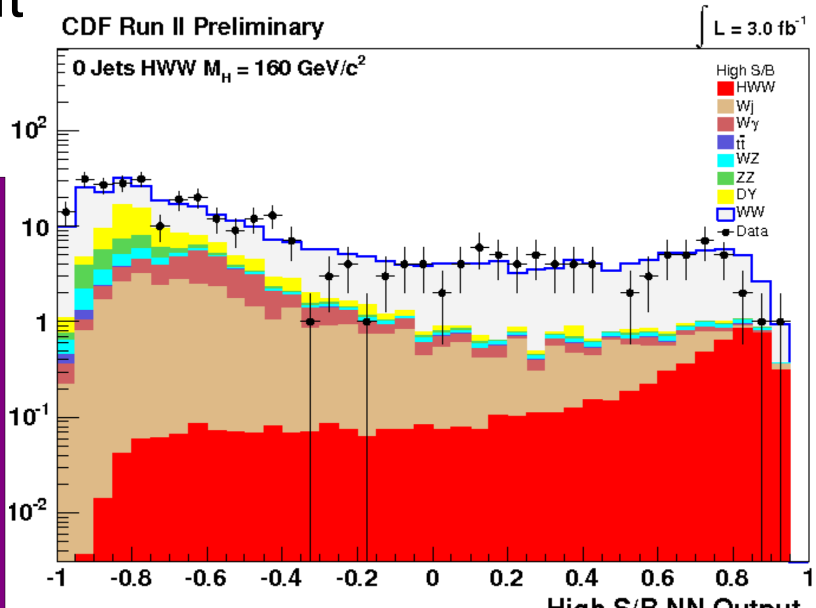




H → WW + 0 Jet Analysis

- Only consider gg → H production
- Dominant background WW
- Inputs to Neural Network
  - Use kinematic variables and matrix element likelihood ratios
  - Limits calculated from NN output distributions using Bayesian approach

HWW 0 Jets	$M_H = 160$	Bkgd	Data
High S/B	7	320	322
Low S/B	2	220	230



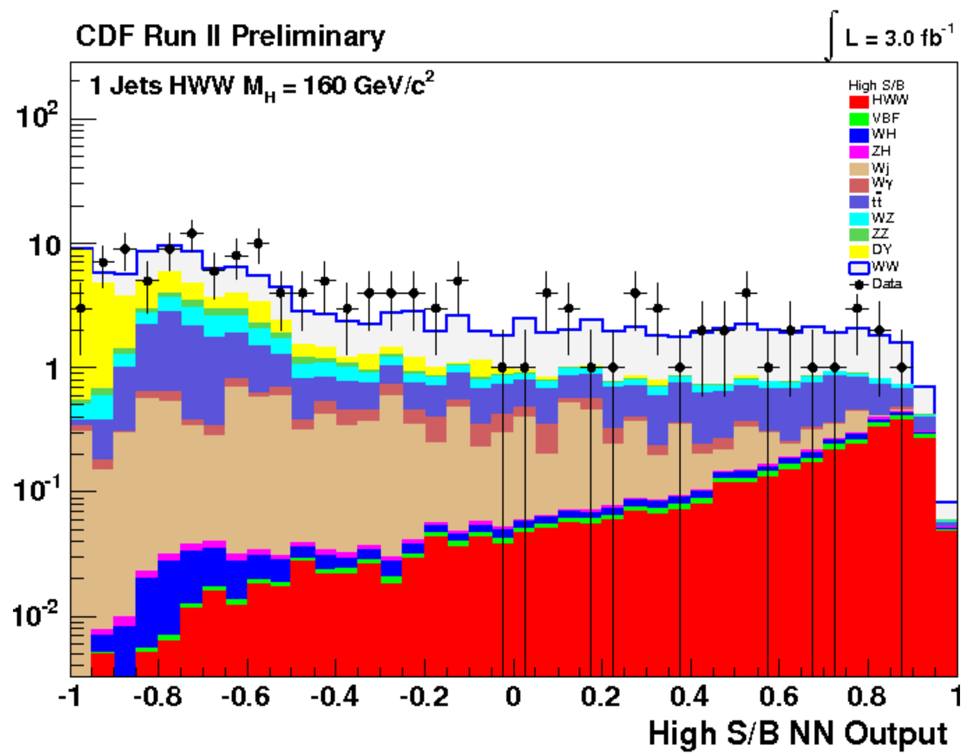
$$P(\vec{x}_{obs}) = \frac{1}{\langle\sigma\rangle}\int \frac{d\sigma_{th}(\vec{y})}{d\vec{y}}\,\varepsilon(\vec{y})\,G(\vec{x}_{obs},\vec{y})\,d\vec{y}$$

$$LR_m = \frac{P_m(\vec{x}_{obs})}{P_m(\vec{x}_{obs})+\sum_i k_i P_i(\vec{x}_{obs})}$$

$H \rightarrow WW$ + 1 Jet Analysis

- Include VH and VBF signal
  - Adds ~1 event (additional 20% signal)
- Dominant background still WW
  - Drell-Yan similar size
- 8 kinematic input variables to Neural Network
  - Matrix elements only calculated for 0 jet events

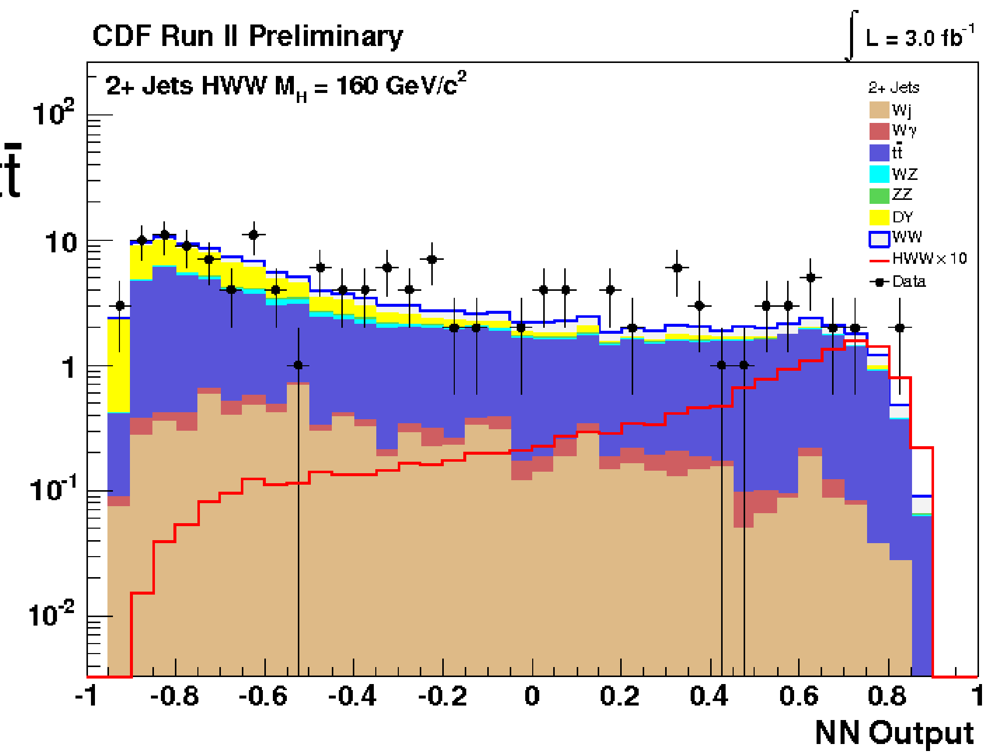
HWW 1 Jets	$M_H = 160$	Bkgd	Data
High S/B	4	150	143
Low S/B	1	76	84



$H \rightarrow WW + \geq 2$ Jets Analysis

- No separation by lepton quality due to low statistics
- VH and VBF signal contributions dominant (60%)
- Largest background is $t\bar{t}$
  - Anti-*b*-tagging reduces $t\bar{t}$ background by > 50%
  - $t\bar{t}$ still accounts for half of background events
- 8 kinematic inputs to Neural Network

HWW ≥ 2 Jets	$M_H = 160$	Bkgd
All S/B	4	129
Data	139	



$H \rightarrow WW \rightarrow l\nu l\nu$ Systematics

Syst(%)	Signal	ΣBkg
JES	8.7	1.1
Lepton Energy	3.1	0.0
Miss Et Model	1.0	2 - 5
Conversion	0	1 - 4
WW NLO	10	10
σ (PDF, scale)	12	10
Multijet	0	4
Lepton ID	1.9	1.9

- Two classes of systematic:

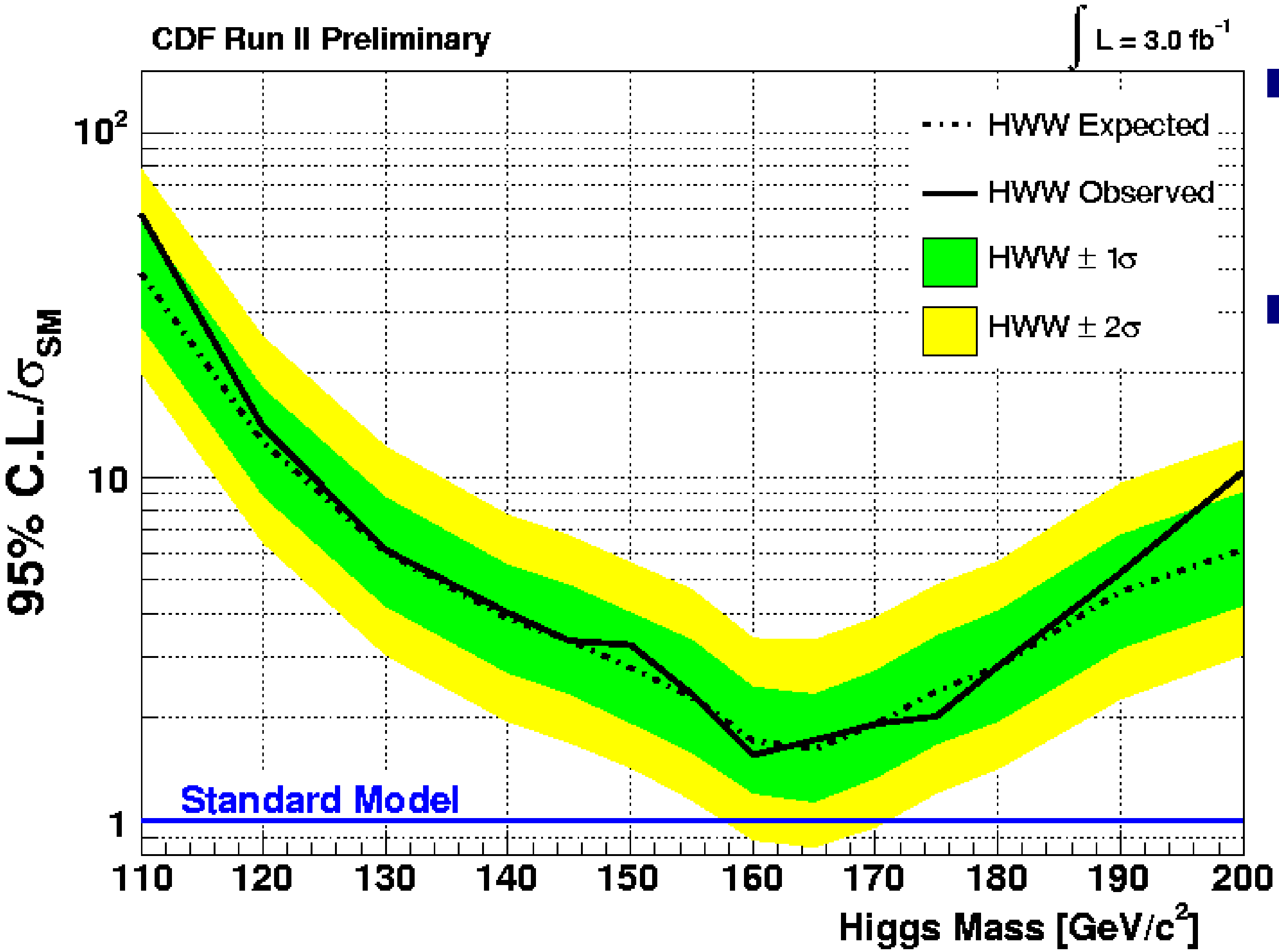
Shape systematics

  - Modify output of discriminant
  - Studied but found to be negligible

Flat systematics

  - Affect only normalization, do not modify shape

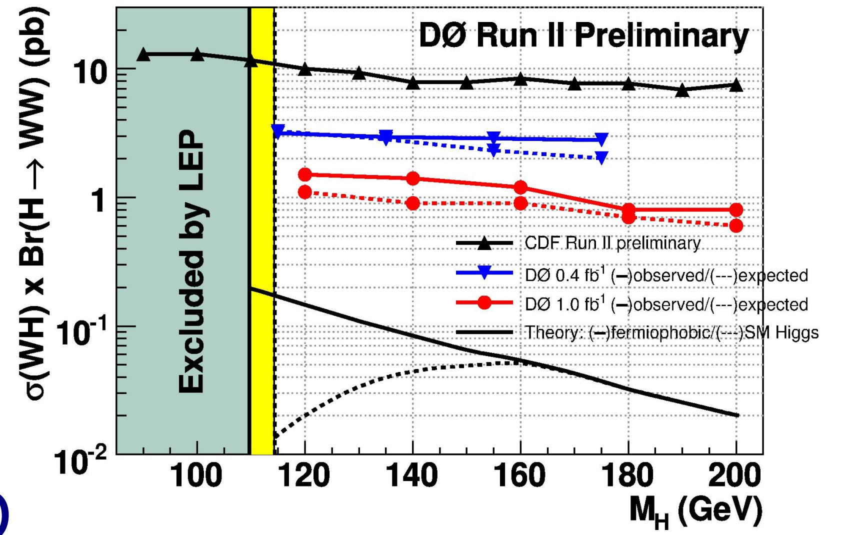
$H \rightarrow WW \rightarrow l\nu l\nu$ Limits

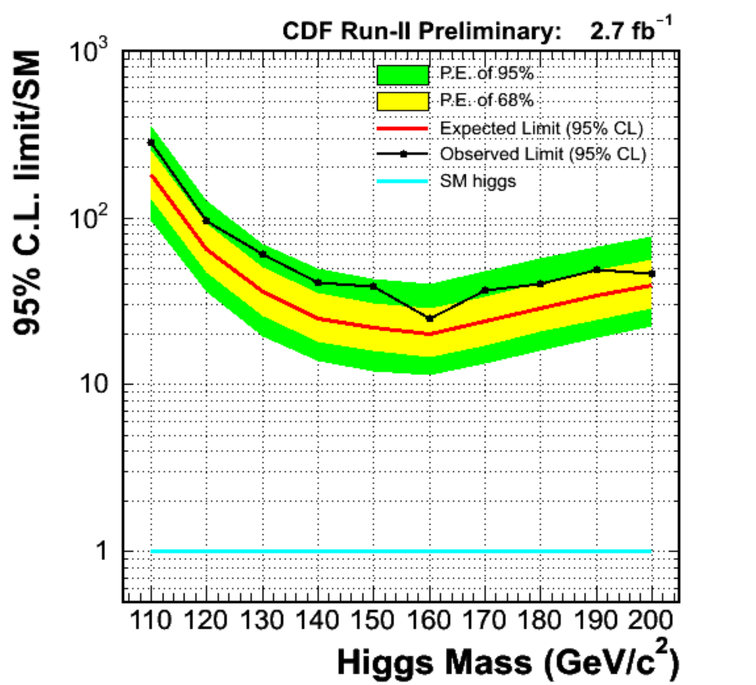


- Combine jet channels into one result
- At M_H = 165,
  - Expected limit of 1.6 x σ_{SM}
  - Observed of 1.7 x σ_{SM}

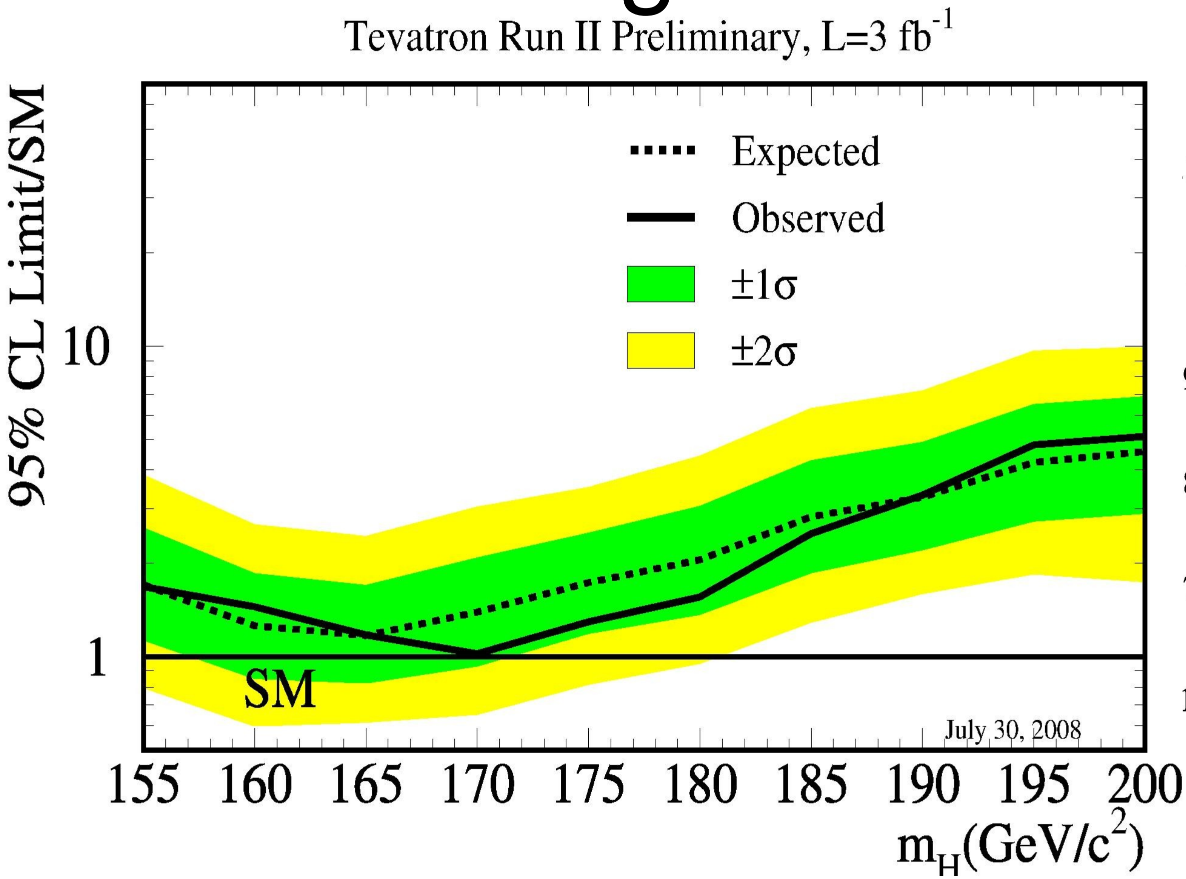
WH → WWW → ll + X

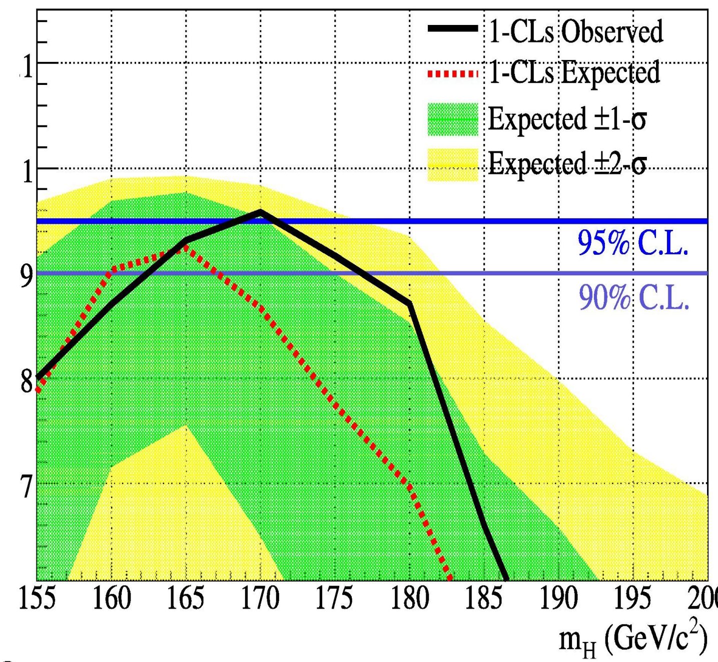
- WH → WWW → $\ell^{\pm}\ell^{\pm}$ + X
  - Signature is like-sign dileptons
  - Background primarily from charge misidentification
  - Adds to high mass sensitivity
- D0 analysis uses 1 fb^{-1} and 2-D likelihood discriminant
  - Results at 160: 24 (18) x σ_{SM} observed (expected)
- CDF analysis uses 2.7 fb^{-1} and Boosted Decision Tree
  - Results at 160: 25 (20) x σ_{SM} observed (expected)





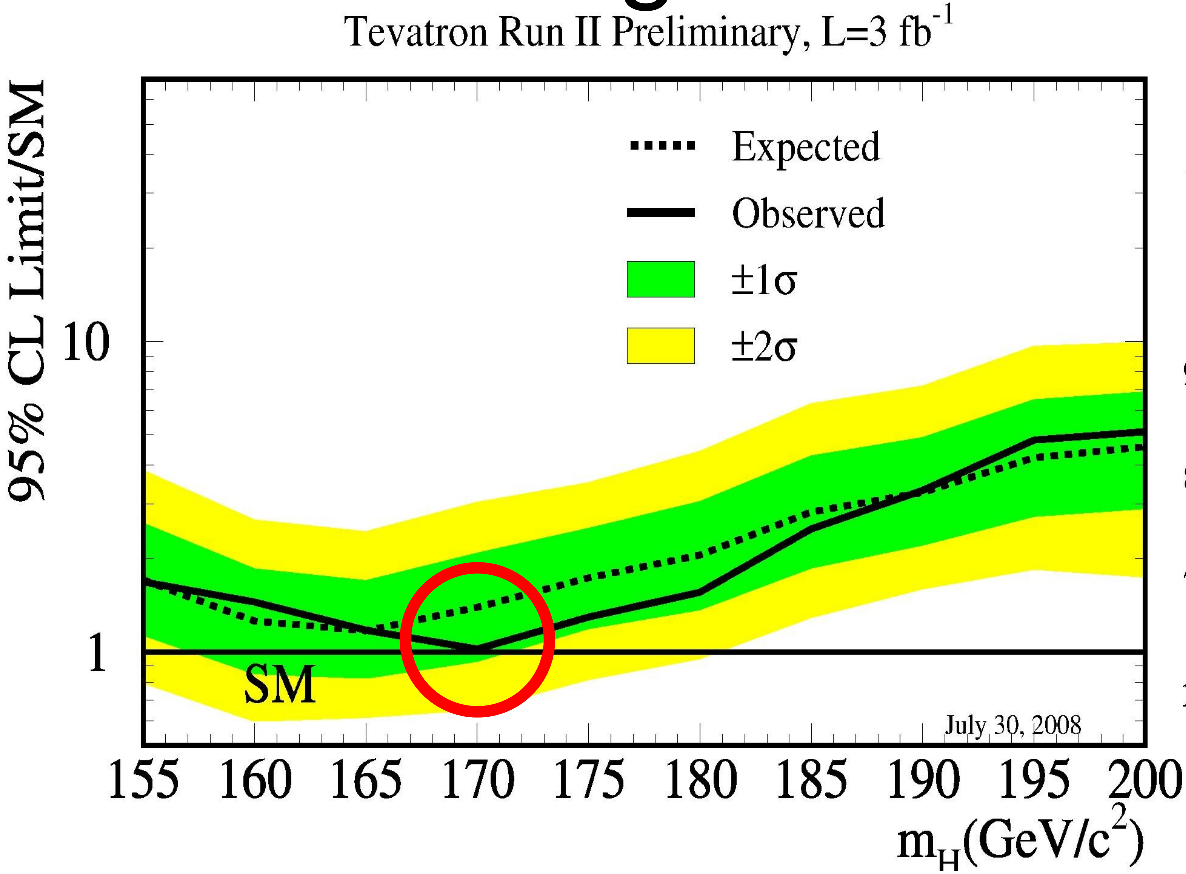
Tevatron High Mass Combination

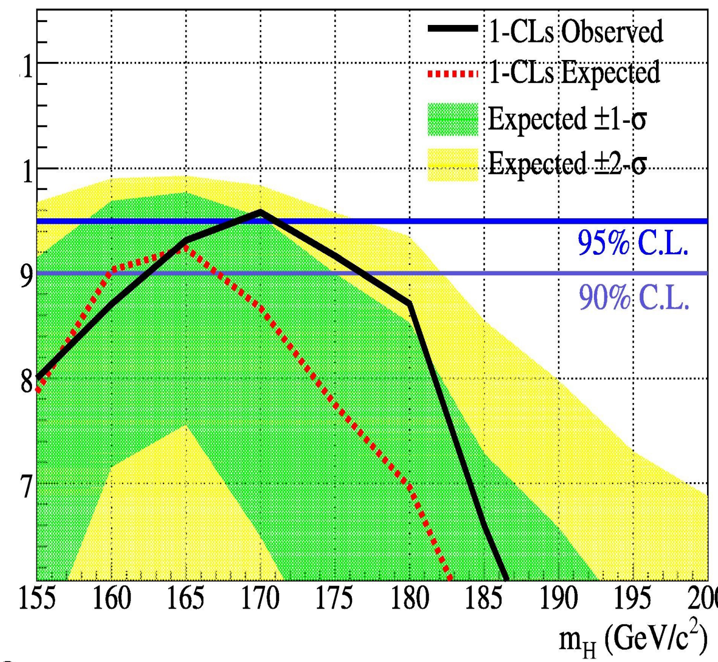




- Combine CDF and D0 results into an overall Tevatron Higgs limit
  - Calculate both Bayesian and CL_S limits

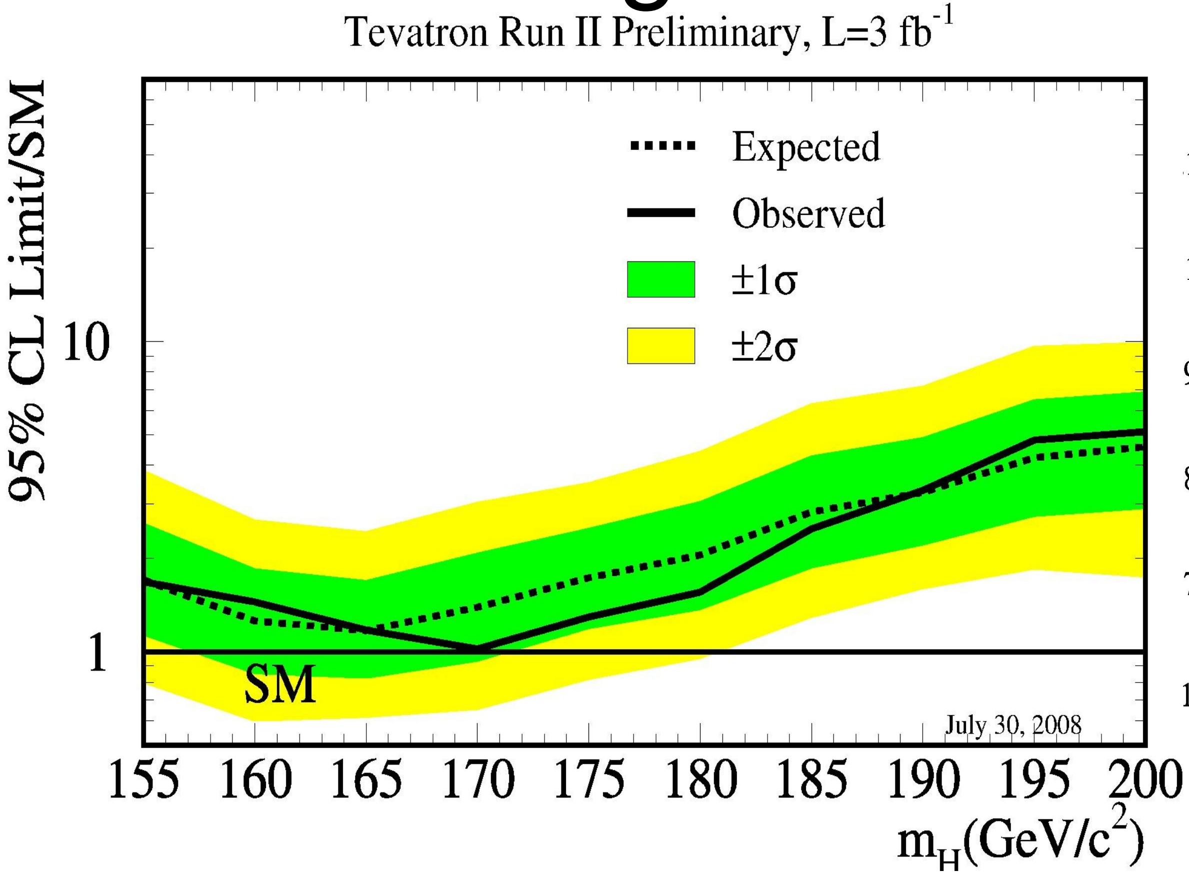
Tevatron High Mass Combination

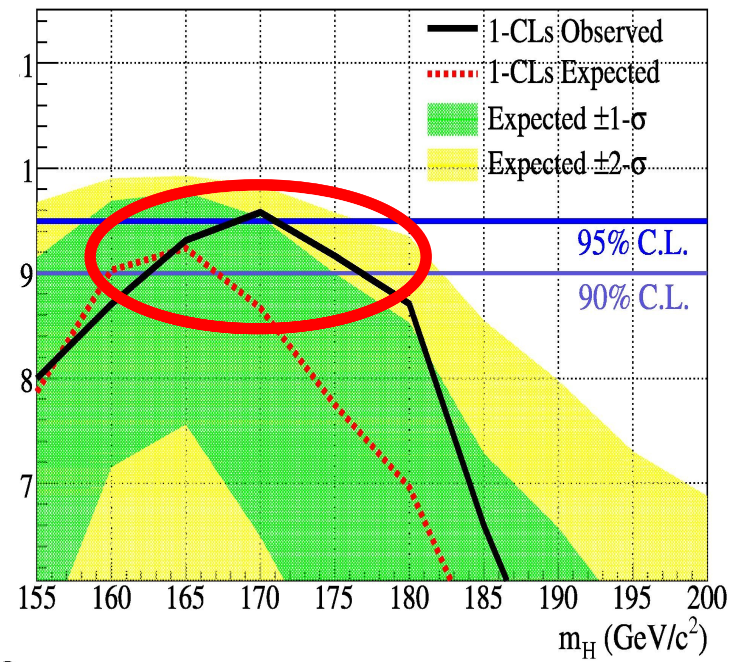




- At M_H = 170, expected limit is 1.4 x σ_{SM}
- Observed limit is 1.0 x $\sigma_{SM} \rightarrow$ First Tevatron exclusion!

Tevatron High Mass Combination

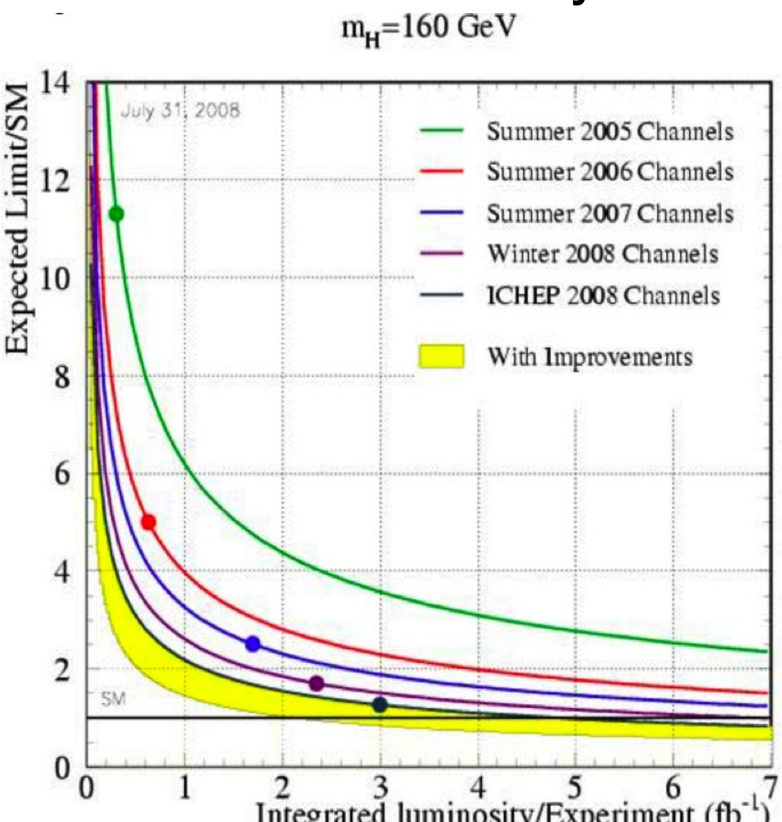




- Exclude range of ~165 to 170 at 90% confidence level
- Results first shown at ICHEP 2008

Summary

- Exciting times for Higgs searches!
- Tevatron making great strides in high mass searches
  - Sensitivity continues to improve faster than luminosity scaling
  - Rapid incorporation of new data and analysis improvements
  - Both experiments approaching Standard Model sensitivity
  - New update expected soon
- Tevatron excludes at 95% C.L. production of a SM Higgs boson of 170 GeV
  - More to come...



Extra Slides

Tevatron 3.0 fb^{-1} Combination

- Preliminary results presented at ICHEP 2008
- Available as arXiv: 0808.0534v1 [hep-ex]

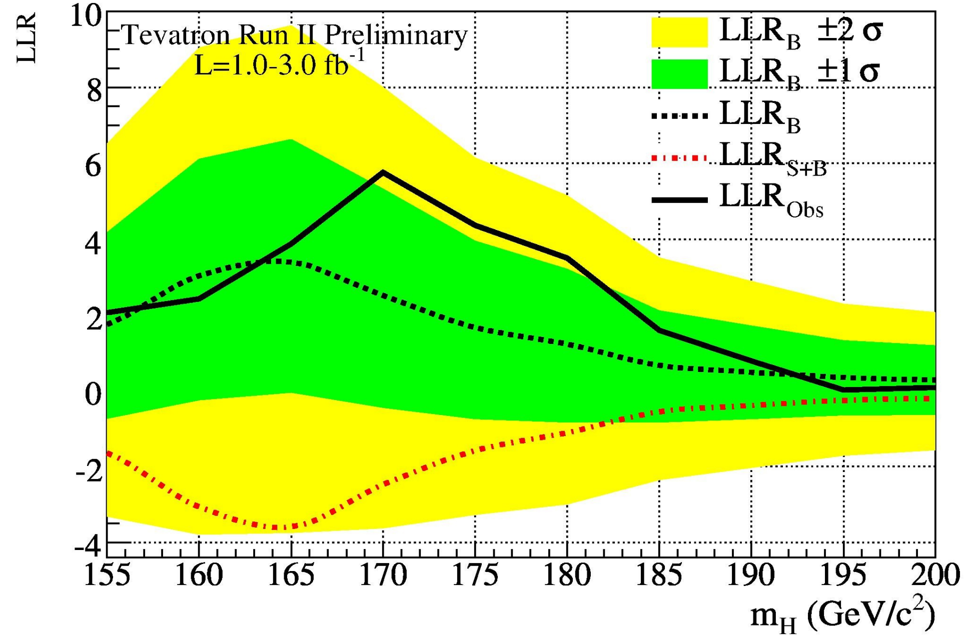


TABLE IX: Ratios of median expected and observed 95% CL limit to the SM cross section for the combined CDF and DØ analyses as a function of the Higgs boson mass in GeV/c^2, obtained with the Bayesian method.

	155	160	165	170	175	180	185	190	195	200
Expected	1.7	1.3	1.2	1.4	1.7	2.0	2.8	3.3	4.2	4.6
Observed	1.7	1.4	1.2	1.0	1.3	1.6	2.5	3.3	4.8	5.1

TABLE X: Ratios of median expected and observed 95% CL limit to the SM cross section for the combined CDF and DØ analyses as a function of the Higgs boson mass in GeV/c^2, obtained with the CL_S method.

	155	160	165	170	175	180	185	190	195	200
Expected	1.6	1.2	1.1	1.3	1.7	2.0	2.8	3.4	4.2	4.7
Observed	1.6	1.3	1.1	0.95	1.2	1.4	2.3	3.2	4.7	5.0

$H \rightarrow WW \rightarrow l\nu l\nu$ Systematics

	Σ Bkgd	Signal	$Z \rightarrow ee$	$Z \rightarrow \tau\tau$	$W + jets/\gamma$	$t\bar{t}$	ZZ	WZ	WW	QCD
JES +	-0.93	-0.30	-1.80	0.00	-0.91	-0.52	-0.19	-1.38	-0.02	-
JES -	1.15	0.00	3.70	-26.67	0.62	0.26	0.58	-1.24	-0.02	-
$JER\ Up$	-0.12	-0.30	0.27	0.00	-0.44	-0.07	0.58	-0.69	-0.21	-
$JER\ Down$	0.29	0.00	-0.65	0.00	-0.44	5.44	0.00	-0.97	-0.07	-
Jet ID	6.05	0.00	21.54	0.00	0.00	0.19	0.78	0.41	0.00	-
$\mathcal{L}$ Rew	-0.26	-0.21	-1.44	-9.97	0.06	-0.58	2.64	-1.41	1.07	-
Beam Rew	0.90	0.62	1.63	9.07	0.51	0.40	1.06	0.66	0.77	-
$Z - p_T$ Rew	-4.62	0.00	-16.45	-10.88	0.00	0.00	0.00	0.00	0.00	-
WW NLO	3.00	6.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
σ	-	4	5	5	5	5	5	5	5	-
QCD	2	0	-	-	-	-	-	-	-	-
PDF	4	4	-	-	-	-	-	-	-	-
Norm.	2	2	-	-	-	-	-	-	-	-
Lep. ID.	5.7	5.7	-	-	-	-	-	-	-	-
Charge flips	-	1.0	1.0	-	-	-	-	-	-	-

H → WW → $l\nu l\nu$ Events

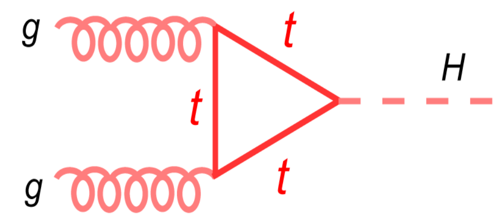
	$e\mu$ pre-selection	$e\mu$ final	ee pre-selection	ee final	$\mu\mu$ pre-selection	$\mu\mu$ final
$Z \to ee$	209.0 ± 3.0	0.72 ± 0.16	160463 ± 264	73.6 ± 5.1	–	–
$Z \to \mu\mu$	151.1 ± 0.6	2.14 ± 0.06	-	-	256432 ± 230	957 ± 14
$Z \to \tau\tau$	2312 ± 2	2.45 ± 0.05	835 ± 8	1.0 ± 0.3	1968 ± 11	5.5 ± 0.5
$t\bar{t}$	187.5 ± 0.2	54.2 ± 0.1	96.9 ± 0.2	28.5 ± 0.1	19.4 ± 0.1	10.1 ± 0.1
$W + jets$	163.4 ± 5.3	60.1 ± 3.2	174 ± 7	72.0 ± 4.3	149 ± 3	85.8 ± 2.1
WW	285.6 ± 0.1	108.0 ± 0.1	127.5 ± 0.4	45.7 ± 0.2	162.9 ± 0.5	91.3 ± 0.3
WZ	14.8 ± 0.1	4.9 ± 0.1	89.6 ± 0.8	7.6 ± 0.2	51.6 ± 0.5	16.2 ± 0.3
ZZ	3.47 ± 0.01	0.49 ± 0.01	73.5 ± 0.3	5.4 ± 0.1	43.0 ± 0.2	13.5 ± 0.1
Multi-jet	190 ± 168	1 ± 8	2322 ± 193	4.3 ± 8.3	945 ± 31	63.6 ± 8.0
Signal ($m_H = 160$ GeV)	9.0 ± 0.1	6.9 ± 0.1	4.40 ± 0.01	3.49 ± 0.01	4.7 ± 0.1	4.09 ± 0.06
Total Background	3516 ± 168	234 ± 9	164181 ± 327	238 ± 11	259770 ± 232	1242 ± 16
Data	3706	234	164290	236	263743	1147

- Total background ~ 1600 events
  - Largest background contribution varies by dilepton type
- Total signal for SM Higgs of 160 GeV: 15 events
  - Expected background events agrees well with events seen in data

H $\rightarrow$ WW 0 Jet Systematics

0 Jet Uncertainties	WW	WZ	ZZ	$t\bar{t}$	DY	$W\gamma$	W+jet	$gg \rightarrow H$	WH	ZH	VBF
Cross Section											
Scale								10.9%			
PDF Model								5.1%			
Total	*10.0%*	*10.0%*	*10.0%*	15.0%	5.0%	10.0%		12.0%			
Acceptance											
Scale (leptons)								2.5%			
Scale (jets)								4.6%			
PDF Model (leptons)	1.9%	2.7%	2.7%	2.1%	4.1%	2.2%		1.5%			
PDF Model (jets)								0.9%			
Higher-order Diagrams	**5.5%**	**10.0%**	**10.0%**	10.0%	**5.0%**	**10.0%**					
Missing Et Modeling	1.0%	1.0%	1.0%	1.0%	20.0%	1.0%		1.0%			
Conversion Modeling						20.0%					
Jet Fake Rates											
(Low S/B)							21.5%				
(High S/B)							27.7%				
MC Run Dependence	3.9%			4.5%		4.5%		3.7%			
Lepton ID Efficiencies	2.0%	1.7%	2.0%	2.0%	1.9%	1.4%		1.9%			
Trigger Efficiencies	2.1%	2.1%	2.1%	2.0%	3.4%	7.0%		3.3%			
Luminosity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%		5.9%			

$H \rightarrow WW$ + 0 Jet Analysis



- Only consider $gg \rightarrow H$ production
  - Small contribution from VH and VBF
- Inputs to Neural Network
  - Kinematic:
    - $\Delta R(ll)$, $\Delta\phi(ll)$, transverse mass H_T
  - Matrix element likelihood ratios
    - LR_{HWW} and LR_{WW}

$$P(\vec{x}_{obs}) = \frac{1}{\langle\sigma\rangle} \int \frac{d\sigma_{th}(\vec{y})}{d\vec{y}} \varepsilon(\vec{y})\, G(\vec{x}_{obs}, \vec{y})\, d\vec{y}$$

$$LR_m = \frac{P_m(\vec{x}_{obs})}{P_m(\vec{x}_{obs}) + \sum_i k_i P_i(\vec{x}_{obs})}$$

CDF Run II Preliminary			$\int \mathcal{L} = 3.0\ \mathrm{fb}^{-1}$
	$M_H = 160\ \mathrm{GeV}/c^2$		
$t\bar{t}$	0.96	$\pm$	0.19
DY	66.88	$\pm$	15.20
WW	280.42	$\pm$	38.99
WZ	12.17	$\pm$	1.93
ZZ	17.29	$\pm$	2.74
W+jets	83.61	$\pm$	20.09
$W\gamma$	79.15	$\pm$	21.12
Total Background	**540.48**	$\pm$	**64.81**
$gg \rightarrow H$	8.38	$\pm$	1.29
Total Signal	**8.38**	$\pm$	**1.29**
Data		**552**	

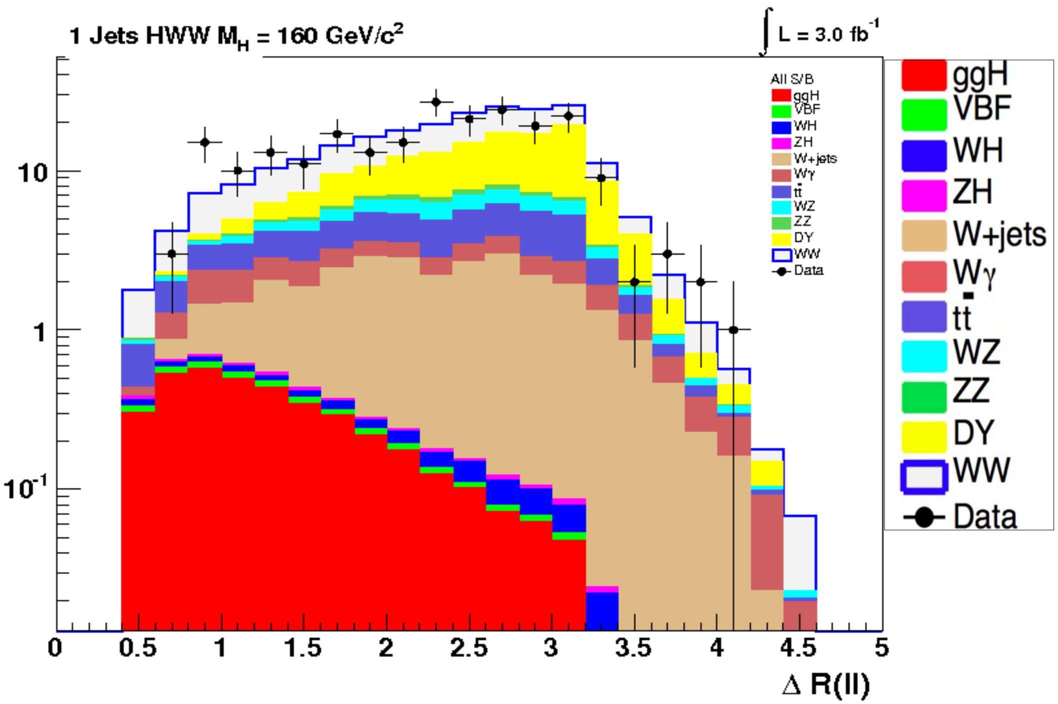
HWW 0 Jet

H → WW 1 Jet Systematics

1 Jet Uncertainties	WW	WZ	ZZ	$t\bar{t}$	DY	$W\gamma$	W+jet	$gg \to H$	WH	ZH	VBF
Cross Section											
Scale								10.9%			
PDF Model								5.1%			
Total	*10.0%*	*10.0%*	*10.0%*	15.0%	5.0%	10.0%		12.0%	5.0%	5.0%	10.0%
Acceptance											
Scale (leptons)								2.8%			
Scale (jets)								-5.1%			
PDF Model (leptons)	1.9%	2.7%	2.7%	2.1%	4.1%	2.2%		1.7%	1.2%	0.9%	2.2%
PDF Model (jets)								-1.9%			
Higher-order Diagrams	**5.5%**	**10.0%**	**10.0%**	10.0%	**5.0%**	**10.0%**			*10.0%*	*10.0%*	*10.0%*
Missing Et Modeling	1.0%	1.0%	1.0%	1.0%	20.0%	1.0%		1.0%	1.0%	1.0%	1.0%
Conversion Modeling						20.0%					
Jet Fake Rates											
(Low S/B)							22.2%				
(High S/B)							31.5%				
MC Run Dependence	1.8%			2.2%		2.2%		2.6%	2.6%	1.9%	2.8%
Lepton ID Efficiencies	2.0%	2.0%	2.2%	1.8%	2.0%	2.0%		1.9%	1.9%	1.9%	1.9%
Trigger Efficiencies	2.1%	2.1%	2.1%	2.0%	3.4%	7.0%		3.3%	2.1%	2.1%	3.3%
Luminosity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%		5.9%	5.9%	5.9%	5.9%

H → WW + 1 Jet Analysis

- Dominant background still WW
  - Drell-Yan bkg of similar size
- Do not calculate matrix element likelihood ratio for 1 jet events



CDF Run II Preliminary $\int \mathcal{L} = 3.0\ \mathrm{fb}^{-1}$

$M_H = 160\ \mathrm{GeV}/c^2$

$t\bar{t}$	24.57	±	4.77
DY	71.21	±	16.19
WW	75.10	±	10.11
WZ	12.71	±	2.02
ZZ	4.53	±	0.72
W+jets	26.23	±	6.78
$W\gamma$	11.35	±	3.00
Total Background	**225.69**	±	**28.21**
$gg \to H$	4.08	±	0.63
WH	0.57	±	0.08
ZH	0.21	±	0.03
VBF	0.33	±	0.05
Total Signal	**5.18**	±	**0.69**
Data	**227**		

HWW 1 Jet

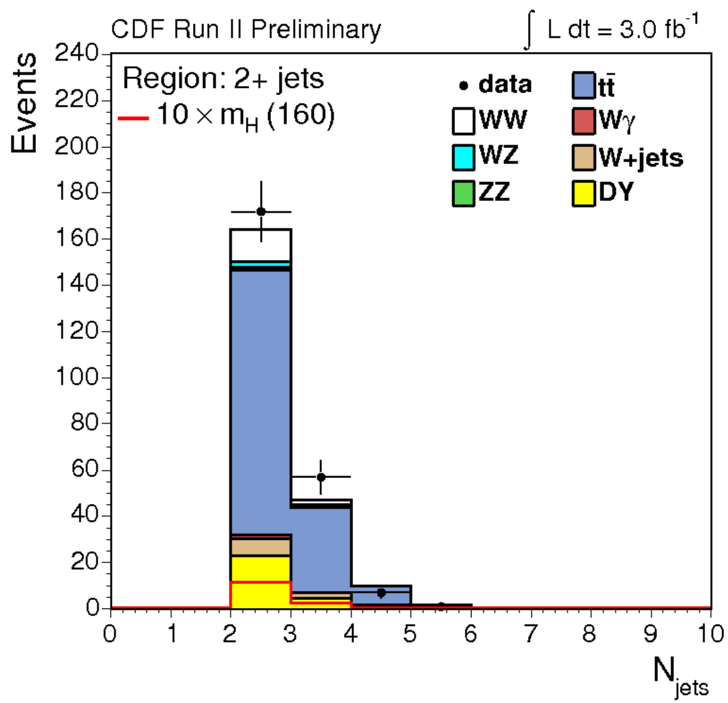
- Include VH and VBF signal
  - Adds ~1 event (additional 20% signal)

H → WW ≥ 2 Jets Systematics

$\geq$ 2 Jets Uncertainties	WW	WZ	ZZ	$t\bar{t}$	DY	$W\gamma$	W+jet	$gg \to H$	WH	ZH	VBF
Cross Section											
Scale								10.9%			
PDF Model								5.1%			
Total	*10.0%*	*10.0%*	*10.0%*	15.0%	5.0%	10.0%		12.0%	5.0%	5.0%	10.0%
Acceptance											
Scale (leptons)								3.1%			
Scale (jets)								-8.7%			
PDF Model (leptons)	1.9%	2.7%	2.7%	2.1%	4.1%	2.2%		2.0%	1.2%	0.9%	2.2%
PDF Model (jets)								-2.8%			
Higher-order Diagrams	**10.0%**	**10.0%**	**10.0%**	10.0%	**10.0%**	**10.0%**			*10.0%*	*10.0%*	*10.0%*
Missing Et Modeling	1.0%	1.0%	1.0%	1.0%	20.0%	1.0%		1.0%	1.0%	1.0%	1.0%
Conversion Modeling						20.0%					
b-tag Veto				7.0%							
Jet Fake Rates							27.1%				
MC Run Dependence	1.0%			1.0%		1.0%		1.7%	2.0%	1.9%	2.6%
Lepton ID Efficiencies	1.9%	2.9%	1.9%	1.9%	1.9%	1.9%		1.9%	1.9%	1.9%	1.9%
Trigger Efficiencies	2.1%	2.1%	2.1%	2.0%	3.4%	7.0%		3.3%	2.1%	2.1%	3.3%
Luminosity	5.9%	5.9%	5.9%	5.9%	5.9%	5.9%		5.9%	5.9%	5.9%	5.9%

H → WW + ≥ 2 Jets Analysis

- No separation by lepton quality due to low statistics
- Dominant background $t\bar{t}$
  - Anti-*b*-tagging reduces $t\bar{t}$ background by > 50%



CDF Run II Preliminary $\int \mathcal{L} = 3.0\ \text{fb}^{-1}$

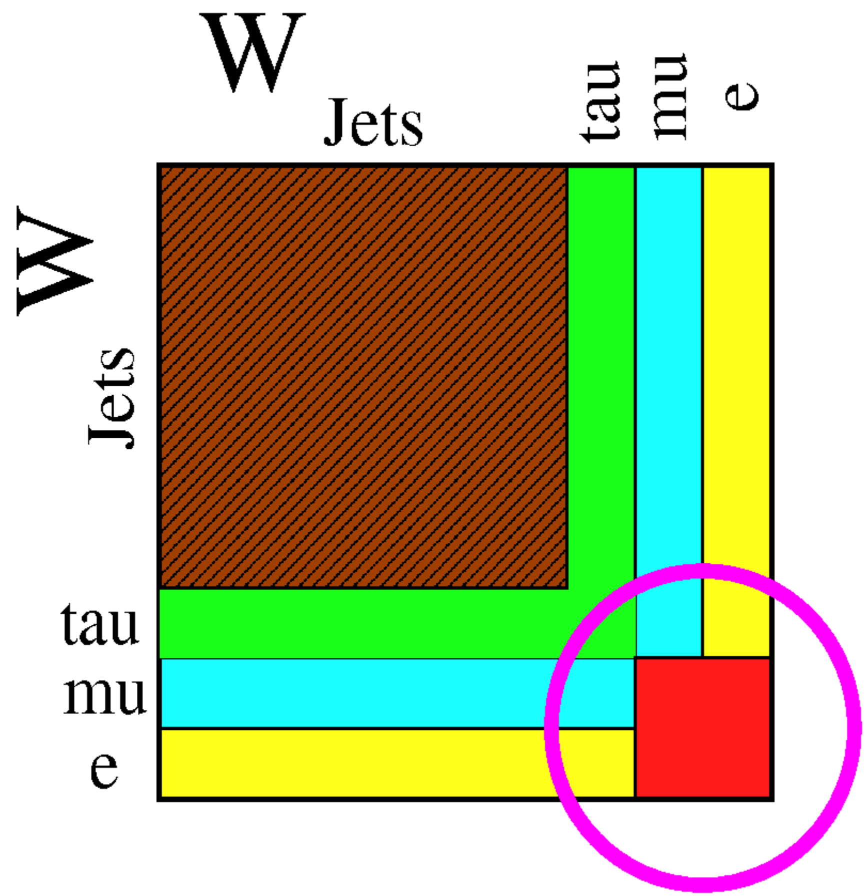
$M_H = 160\ \text{GeV}/c^2$			
$t\bar{t}$	$\boxed{70.34}$	±	14.46
DY	27.74	±	6.75
WW	15.68	±	2.47
WZ	3.33	±	0.53
ZZ	1.35	±	0.21
W+jets	8.38	±	2.27
$W\gamma$	1.80	±	0.47
Total Background	**128.62**	±	**20.19**
$gg \rightarrow H$	1.52	±	0.26
WH	1.18	±	0.16
ZH	0.59	±	0.08
VBF	0.61	±	0.10
Total Signal	**3.90**	±	**0.45**
Data	**139**		

HWW ≥ 2 Jets

- VH and VBF contributions dominant (60%)

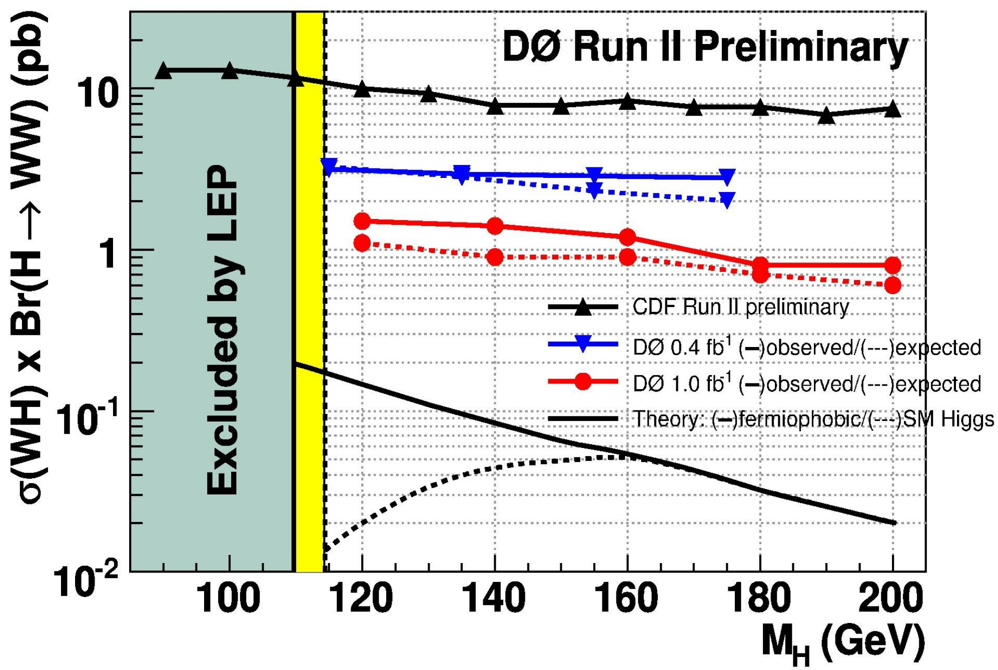
$H \rightarrow W^+W^-$ Final States

- W decay modes
  - Leptonic 33% (e, μ)
  - Hadronic 67%
- Dilepton (e, μ): BR ~ 6%
  - Sensitive to $\tau \rightarrow$ (e, μ)
  - Small BR, but...
    clean, easy to trigger
- Lepton + τ_{had}: BR ~ 4%
  - Potentially useful
- Lepton + jets: BR ~ 30%
  - Large W+jets background
- All hadronic: BR ~ 45%
  - Large QCD background



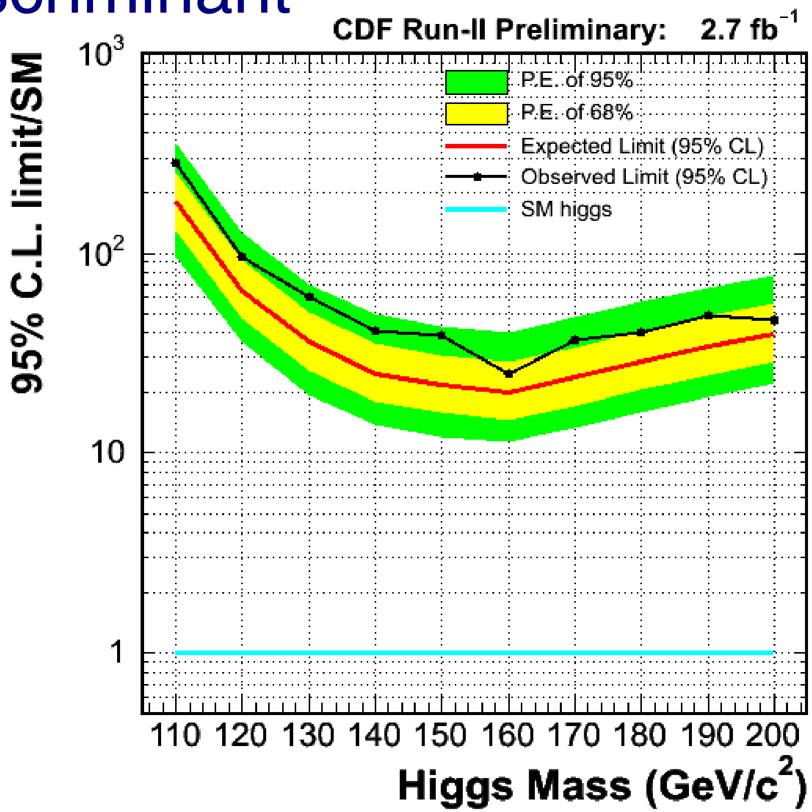
$WH \to WWW \to ll + X$

- Search for $WH \to WWW \to l^{\pm} l^{\pm} + X$ using 1 fb^{-1}
  - Signature is like-sign dileptons (ee, μμ, eμ)
  - Background primarily from charge misidentification
- Use 2-D likelihood discriminant
  - Separate physics bkg from charge misid bkg
  - Input variables:
    - $\Delta\phi(ll)$, M_{ll}, $\not{E}_T$, $\Delta\phi^{min}(l, \not{E}_T)$, and $\not{E}_T^{had}$
- Results at M_H = 160:
  - Expected 18 x σ_{SM}
  - Observed 24 x σ_{SM}

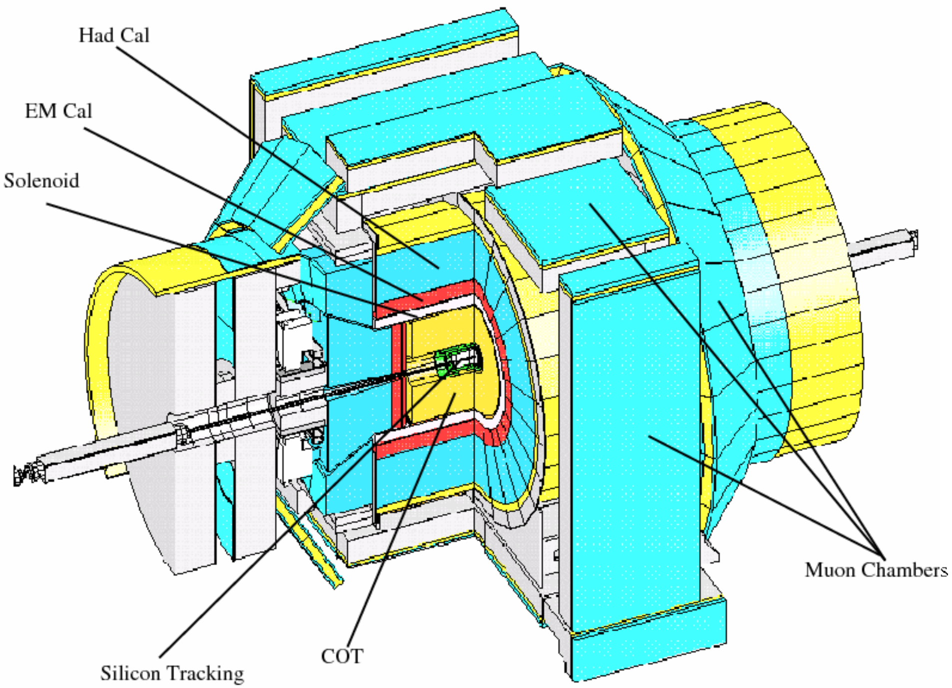


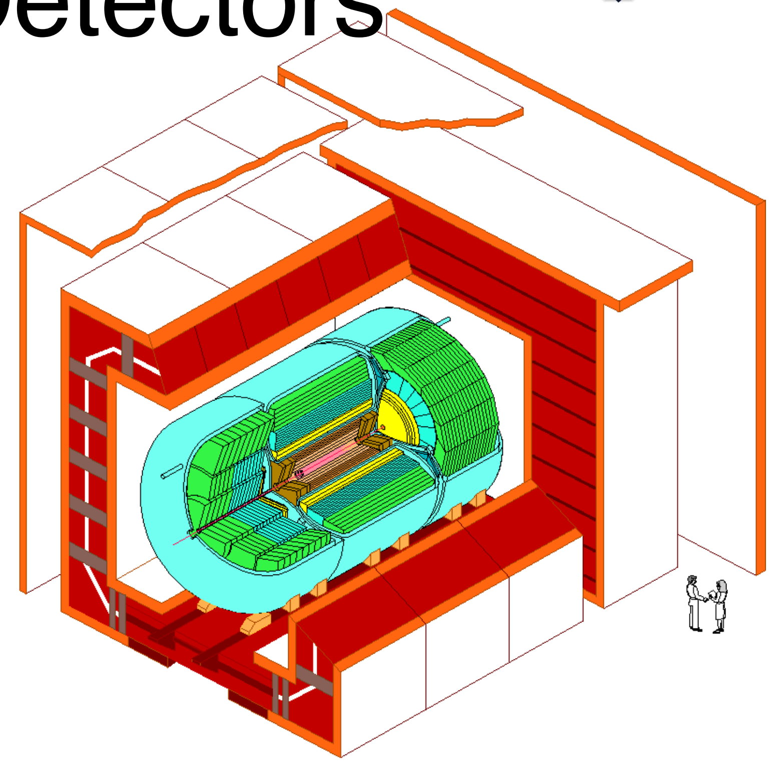
$WH \to WWW \to \ell\ell + X$

- Search for $WH \to WWW \to \ell^{\pm}\ell^{\pm} + X$ using 2.7 fb^{-1}
  - Again, signature is like-sign dileptons (ee, $\mu\mu$, eμ)
  - Main background is charge misidentification
- Use Boosted Decision Tree discriminant
  - Trained at each M_H (10 GeV)
  - 8 kinematic input variables:
    - $p_T(\ell_1)$, $p_T(\ell_2)$, $p_T(\ell\ell)$, $\not{E}_T$, $M_{\ell\ell}$, $\not{E}_T^{spec}$, H_T, and N_{jets}
- Results for M_H = 160:
  - Expected 20 x σ_{SM}
  - Observed 25 x σ_{SM}



CDF and D0 Detectors





DØ Detector

- CDF
  - Silicon inner tracker, wire drift chamber outer
  - EM and had calorimeters
  - Muon coverage $|\eta| < 1.5$
- D0
  - Silicon inner tracker, fiber outer tracker
  - LAr-U calorimeter
  - Good muon coverage